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(54) IMPROVEMENTS IN OR RELATING TO CONCRETE

(71) We, THE ELECTRICITY COUNCIL, a British Body Corporate, of 30, Millbank, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to concrete and is concerned with making a concrete which is electrically conductive. Concrete is produced from a cement mortar and an aggregate, the expression "cement mortar" being used in this specification to refer to a material formed from cement, sand and water.

There are many possible uses for a concrete which is electrically conductive to a sufficient extent, for example with a resistivity of 1 ohm metre, that it can readily be heated by the application of an electrical current. Such material could be used for example for underfloor storage heating. As another example it could be used in road and runway construction to enable the surface to be de-iced quickly.

According to this invention there is provided an electrically conductive concrete employing a cement mortar and an aggregate wherein the mortar contains a finely divided electrical conductor and the aggregate is an electrically conductive material or is a material coated with a thin conductive film. The function of the finely divided conductor is to render the mortar and hence the concrete conducting. The conducting aggregate is employed to enhance the conductivity still further. Preferably the finely divided conductive material is carbon black.

In making the concrete, the proportions of cement to aggregate may be chosen in accordance with conventional practice to meet structural requirements, e.g. as to strength.

The mortar may be formed in the known way and is a mixture of cement and sand with water. The amount of the finely divided conductor which is required will determine to a large extent the electrical properties although this will also depend on the proportion of cement to aggregate. The proportion by weight of carbon black to cement may be between 2 and 20%. High proportions of carbon black result in loss of structural strength and preferably the proportion of carbon black to cement is between 2 and 15%.

Typically, the percentage of carbon black to cement will be quite small, between 2 and 7%.

The invention furthermore includes within its scope a method of making an electrically conductive concrete comprising the steps of making a cement mortar with cement, sand and water and with a finely divided electrically conductive material and mixing the mortar with an aggregate which is an electrically conductive material or is a material coated with a thin conductive film.

The following is a description of examples of the invention.

EXAMPLE 1

An electrically conductive mortar was made by mixing a cement phase of 90% by weight Portland cement, 10% carbon black, with 3 parts of sand for each part of cement phase. The carbon black used was that known by the trade name Vulcan XC 72R (Vulcan is a Registered Trade Mark). The mortar was made by mixing the ingredients with water and allowing them to set in accordance with conventional practice for making cement mortars.

The conductivity of the mortar was measured and found to be 0.5 ohm metres.

In making the concrete, the aggregate is made conductive by coating it with thin conductive film; alternately an aggregate of electrically conductive material, e.g. steel particles, may be used.

EXAMPLE 2

A concrete was made using a cement mortar formed by mixing with water two parts of sand with one part of a cement phase, the cement phase containing 6% by weight of carbon black and 94% by weight

of Portland cement. This mortar was made up and mixed with granite chips, which had been coated with silver, to form a concrete. A resistivity of 1.3 ohm-metres was obtained.

It will be appreciated that concretes may be made using different aggregates; the proportion of aggregates and the particle sizes and grading of the aggregate may be chosen in accordance with required properties of the concrete. The mortar is normally formed with about two parts of sand to one of cement but this may be varied. In making concrete using the present invention, the materials and their properties are chosen in accordance with the required mechanical and other properties. Provided the proportion of carbon black is small, say under 15%, the tensile strength of the conductive mortar is similar to that of an ordinary mortar, i.e. without carbon black. The conductivity of the final concrete will depend on the conductivity of the mortar and that of the aggregate. It is possible therefore, by choice of the proportion of carbon black, of the aggregate material and of the coating on the aggregate to obtain a required conductivity with a concrete having required mechanical properties.

In our co-pending Application No. 53921/70 (Serial No. 1,363,428) there is claimed an electrically conductive concrete employing an aggregate and a cement mortar wherein the mortar contains carbon black, the proportion by weight of carbon black to cement being between 2 and 20%.

WHAT WE CLAIM IS:—

1. An electrically conductive concrete employing a cement mortar and an aggregate wherein the mortar contains a finely divided electrical conductor and the aggregate is an electrically conductive material or is a material coated with a thin conductive film.

2. An electrically conductive concrete as claimed in Claim 1 wherein the mortar is formed of Portland cement, sand and water, mixed with the finely divided conductor.

3. An electrically conductive concrete as claimed in either Claim 1 or Claim 2 wherein the finely divided electrical conductor is carbon black.

4. An electrically conductiv concrete as claimed in Claim 3 wherein the proportion by weight of carbon black to cement is between 2 and 20%.

5. An electrically conductive concrete as claimed in Claim 3 when the proportion by weight of carbon black to cement is between 2 and 15%.

6. An electrically conductive concrete as claimed in Claim 3 wherein the proportion by weight of carbon black to cement is between 2 and 7%.

7. A method of making an electrically conductive concrete comprising the steps of making a cement mortar with cement, sand and water and with a finely divided electrically conductive material and mixing the mortar with an aggregate which is an electrically conductive material or is a material coated with a thin conductive film.

8. A method as claimed in Claim 7 wherein the finely divided electrically conductive material is carbon black, the proportion of carbon black to cement being between 2 and 20%.

9. A method as claimed in Claim 8 wherein the proportion of carbon black is between 2 and 15%.

10. A method of making an electrically conductive concrete substantially as hereinbefore described.

11. Concrete made by the method of any of Claims 7 to 10.

12. An electrically conductive concrete substantially as hereinbefore described.

BOULT, WADE & TENNANT,
Chartered Patent Agents,
34 Cursitor Street,
London, EC4A 1PQ.

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